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AUTHOR Narciss, Susanne
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ABSTRACT

The motivational effects of feedback types consisting of the same evaluative components, but differing in the informative components, were studied with 156 German undergraduates in a computer-based learning experiment. A concept-formation task was the learning material. Three feedback conditions were designed: (1) knowledge about result (low informativeness); (2) knowledge about mistakes (medium informativeness); and (3) knowledge on how to proceed (high informativeness). Results show that the informativeness of feedback exerts an influence not only on information processing but also on learner motivation. Greater informative value of the feedback was related to better performance, but the effects of the informativeness of feedback on the motivational variables were moderated by the motivational characteristics of the subjects. (Contains 4 figures and 22 references.) (SLD)

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Susanne Narciss

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Motivational Effects of the Informativeness of Feedback[1]

Susanne Narciss, Institut für Psychologie IV, Technische Universität Dresden

Introduction

Feedback is considered an important construct within many theories of learning and instruction. Many studies investigate multiple forms of feedback and/or feedback conditions, either from a behavioral or from a cognitive viewpoint. Feedback in behavioral studies is considered to reinforce correct responses (for a review see e.g. Kulik & Kulik, 1988). From the cognitive viewpoint feedback is regarded as a source of information necessary for verification, elaboration, concept development, and metacognitive adaptation. The most important instructional effect of feedback would therefore be to correct wrong responses rather than to reinforce correct responses (Kulhavy & Stock, 1989). As meta-analysis of feedback studies show, the instructional benefit of feedback depends on the mindful reception and processing of the provided information (Bangert-Drowns, Kulik, Kulik & Morgan, 1991; Hancock, Thurman & Hubbard, 1995).

Central issues related to the mindful processing of feedback are:

(a) the question on how motivational factors the like self efficacy might affect the processing of feedback (cf. Mory, 1992), and
(b) the question on how informative feedback might affect not only performance but also motivational variables the like persistence in a learning process.

Hence, the purpose of this paper is to examine the impact of the amount of information in a feedback message on motivation and achievement.

Theoretical Framework

Feedback, like any widely used term, is related to a large, if not fuzzy set of meanings. In order to gain a better understanding of the motivational functions of feedback, we propose to describe the feedback message using at least three dimensions: (a) feedback form - feedback is provided under multiple technical or formal conditions (e.g. frequency, amount, delay of feedback); (b) feedback functions - with regard to approaches of self-regulated learning we have to consider different functional levels of feedback. We assume that different feedback types affect learning not only by initiating information processing (e.g. verification and/ or elaboration, see Kulhavy & Stock (1989)), but also by exerting an influence on affective and motivational processes, (c) feedback content - a feedback message might in principle consist of two important components, one component which indicates whether the answer or solution is right or wrong and another component that consists of additional information about the task or solution. As the first component emphasizes the quality of the individual answer or solution of a task, we labelled it "evaluative component". The second component is called the "informational component". Whereas the motivational influence of the evaluative component of a feedback message is examined in detail (e.g., Rheinberg, 1978; Harackiewicz & Larson, 1986; Sansone, 1986; Krampen, 1987; Johnson, Turban, Pieper, & Ng, 1996), the way in which the informative component of a feedback message affects motivation is rarely analyzed nor manipulated systematically. Thus, the aim of our study was to investigate the motivational effects of feedback types consisting of the same evaluative components, but differing in the informative components.

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The informational component of a feedback message may consist of further information necessary to progress when solving a task. As previous studies show, this further information has to be determined carefully. For a simple discrimination task (e.g. assigning colored objects to two boxes), feedback providing just knowledge about result (e.g. right/wrong) would be enough to correct wrong assignments (e.g. Stapf, Fischer & Degner, 1986), whereas for a verbal learning task in a multiple choice format knowledge about the correct response together with the item stem was found to be the sufficient information (e.g. Kulhavy, White, Topp, Chan & Adams, 1985; Phye, 1979; Phye & Bender, 1989). For more complex tasks which do not provide the possible answers in a multiple choice format (e.g. writing tasks, mathematical tasks or concept formation tasks), knowledge about the correct response would provide task solutions, but would not promote transfer or the aquisition of metacognitive strategies and taskprocessing skills. Here information the like knowledge about mistakes (e.g. type of mistake; explications to the mistakes), or knowledge on how to proceed (e.g. hints about useful rules or strategies) should be provided.

Hypothesis about the effectst of different informative components of feedback on motivation and achievement can be derived from cognitve approaches of motivation, modeling the motivational process as a self-regulating system (e.g. Heckhausen, 1989; Weiner, 1992; Bandura, 1991): Cognitive models of achievement motivation posit relationships between variables specific for the actual situation such as goal setting, assessment of performance, satisfaction with one's performance and attribution of performance. Furthermore, they suppose individual motivational characteristics the like self efficacy and/or need of achievement to interact with these situational variables (cf. e.g. Bandura, 1991; Elliot & Church, 1997). Within this perspective the informativeness of feedback could affect the task-specific confidence to proceed successfully, the individual assessment of performance and the satisfaction with one's performance:

Supposing that feedback provides not only evaluative aspects but also the information necessary to progress in a learning or problem solving procedure, this information may contribute to a better achievement. If, as postulated, feedback provides information that facilitates learning or problem solving, then positive assessment of performance or satisfaction with one's performance should increase according to the informativeness of the feedback. Furthermore, getting strategically useful information, the aversive situation to be stuck, not to know how to correct an error might be changed to a less aversive situation, where progress or even the solution is visible and possible. Hence, more informativeness of feedback should not only be related to an increase in achievement and satisfaction, but also in an enhancement of persistence of learning (e.g. Whitehill & McDonald, 1993).

With respect to these hypothesis our aims were to contribute findings to the following questions:

(a) Does the informativeness of feedback facilitate concept formation?
(b) Does the informativeness of feedback affect the individual assessment of performance (satisfaction with one's performance)?
(c) Does the informativeness of feedback affect persistence?
(d) Do individual motivational characteristics the like task specific self efficacy interact with the situational variable "informativeness of feedback"?

Method

Subjects:
156 undergraduate students of psychology, education and communication at Dresden university participated in the computer-based learning experiment (age: 18-36; 44 male; 112 female).

Task and Material:
Bruner's concept-formation task served as learning material (Bruner, Goodnow & Austin, 1956). The characteristics of the stimulus material could vary in form (circle, triangle, square), in the number of objects (1, 2, 3), color (red, blue, green) and/or in the number of frames (1, 2, 3). In order to define a concept these characteristics could be combined in a conjunctive or disjunctive way. The different examples of concepts were represented as cards on a PC-screen (see Fig. 1).

Figure1: Examples of the stimulus cards

We selected 5 different concepts that could unambiguously be identified after a given sequence of 10 cards. Subjects were free to decide how many concepts they would identify.

Design:
The experimental design consisted of the within-factor "concept", the between-subjects factor (3 feedback conditions) and the covariates (individual need of achievement in learning situations [nAch]; task specific self efficacy [SE]). Need of achievement was assessed by a revised German version of Hermans' questionnaire of achievement motivation (Hermans, Zielinski & Petermann, 1976; Narciss & Adam, 1998), task specific self efficacy was assessed by asking subjects to rate three items addressing their confidence solving tasks requiring logical thinking. The dependent variables were concept formation performance (number of cards needed to solve the task), subjective assessment of performance (discrepancy between one's performance and a standard performance) and satisfaction with one's performance (rated on a 10-point-scale).

The three feedback conditions were designed as follows: (a) knowledge about result (informativeness = low): Subjects were told if their actual hypothesis about the concept is right or wrong; (b) knowledge about mistakes (informativeness = medium): Subjects were told if their hypothesis is right or wrong, and if it was wrong, they were told which of the presented cards are not compatible with the supposed concept, (c) knowledge on how to proceed (informativeness = high): Besides the knowledge about result and the knowledge about mistakes subjects received a hint to pay attention to those cards that are not members of the given concept. Subjects were assigned randomly to these experimental conditions.

Procedure
The experiment was conducted in the Multimedia Learning Laboratory of the Department of Psychology at Dresden University. Following an introduction to the session, the subjects completed the achievement motivation questionnaire. Then they received detailed instructions explaining not only the meaning of the term "concept" but also how to proceed in order to solve a concept identification task. Subjects then began performing the task by verifying whether the cards presented by the PC were representatives of the selected concept. Each verification was confirmed or corrected immediately. Subjects were required to identify the selected concept unambiguously. Each time the subjects presented a hypothesis about the concept they received feedback according to their experimental condition. After the identification of the first concept subjects were asked to assess their

performance and to answer the self efficacy items. Then they were asked if they would like to identify another concept. If they agreed the next concept identification task was started.

Results

The data were analyzed using the General Linear Models Procedures of the data analysis system SPSS 7.5. Repeated measures analysis (5 concepts x 3 feedback conditions + 3 covariates) were performed for the dependent variables "concept identification performance", "subjective assessment of performance", "satisfaction with one's performance". The significance level was set at .05.

The first important finding was that more informativeness of feedback was related to a better performance. The subjects under the high-informative feedback condition needed less cards to solve the concepts, than the subjects under the low-informative condition ($F(2, 71) = 3.408$; $MS_e = 54.008$; p=.039; see figure 2). There were no significant effects on performance of the covariates "self efficacy" and "need of achievement".

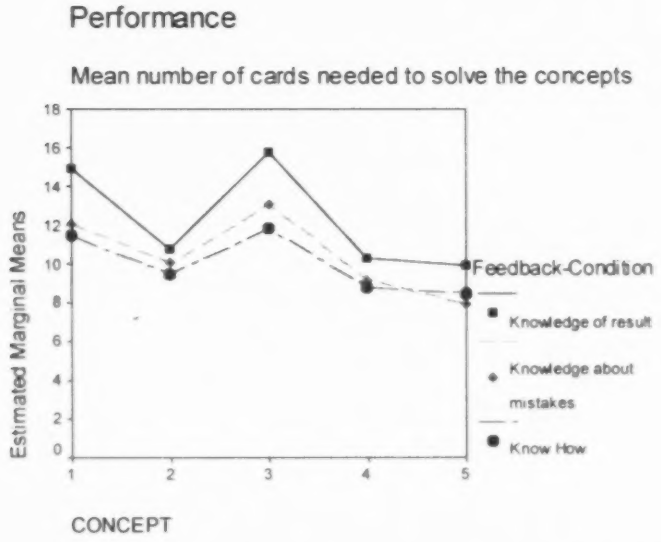

Figure 2: Mean number of cards needed to solve the 5 concepts under three different feedback-conditions: (a) knowledge of result (low informative); (b) knowledge about mistakes (medium informative); (c) knowledge on how to proceed (high informative).

To explore the task specific persistence we performed an analysis of covariance for the number of solved concepts, taking the individual motivational variables (nAch, SE) as covariates. There was no significant main effect of the feedback-condition, but a significant effect of self efficacy with $F(1, 152) = 8{,}310$; $MS_e = 6.219$; p=.005. Thus, we decided to reanalyze the data taking self-efficacy as a second between-factor (three groups: low-self efficacy, medium-self efficacy, high-self efficacy). Analysis of this general factorial design provided a significant main effect for the factor self efficacy $F(2, 147) = 4{,}200$; $MS_e = 5{,}919$, p = .017. Subjects with high self efficacy scores solved significantly more concepts under the high informative feedback condition "know how" than under the low informative condition "knowledge of result" (mean difference = 2,19 concepts; SD = 1,03; p = .03; see figure 3).

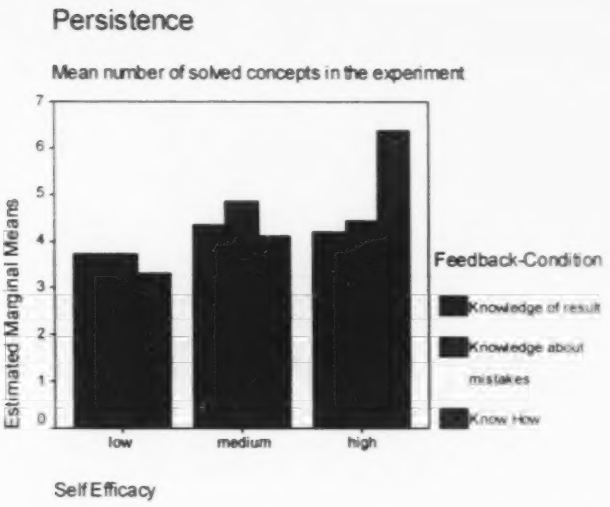

Figure 3: Mean number of solved concepts for three self efficacy groups under three feedback-conditions (a) knowledge of result (low informative); (b) knowledge about mistakes (medium informative); (c) knowledge on how to proceed (high informative).

As subjects were free to decide how many concepts they would identify, many subjects did not work on more than three concepts. Repeated measure analysis for the dependent variable "satisfaction with one's performance" was thus performed for the first three concepts: Analysis of covariance provided no significant main effect of feedback, but indicated a significant effect of the covariate "self efficacy" $F(2, 101) = 5.447$; $MS_e = 8.046$; p=.022. Thus, we performed a more detailed analysis for the variable "satisfaction with one's performance", dividing the whole group into 3 samples using the self-efficacy scores (three groups: low-self efficacy, medium-self efficacy, high-self efficacy). This detailed statistical analysis provided a significant main effect for the factor "self efficacy" $F(4, 96) = 5.064$; $MS_e = 7.917$; p=.008. Furthermore, we found a significant interaction between the factors "concept", "feedback", and "self efficacy" $F(8, 192) = 2.560$; $MS_e = 4.476$, p = .011. Subjects with high self-efficacy scores were significantly more satisfied with their performance under the high informative feedback condition (mean difference = 1.877; $S_e = .721$; p = .014; see figure 4).

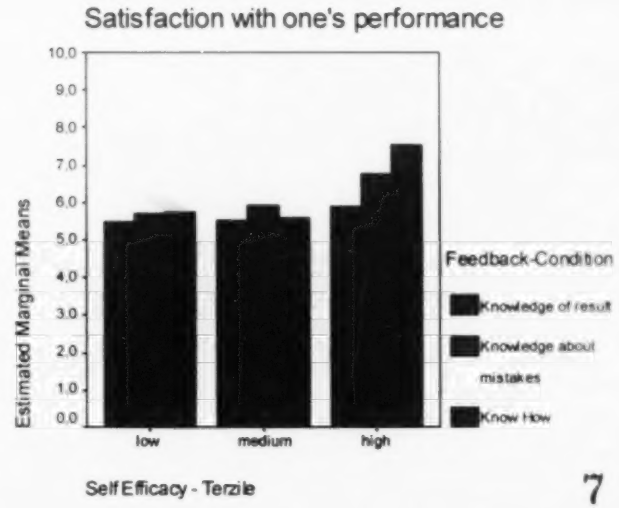

Figure 4: Mean satisfaction with performance for three self efficacy groups under three feedback-conditions (a) knowledge of result (low informative); (b) knowledge about mistakes (medium informative); (c) knowledge on how to proceed (high informative).

Conclusion

In summary, our results show, that the informativeness of feedback exerts not only an influence on information processing but also on learner motivation. Whereas more informativeness of feedback was related to a better performance, the effects of the informativeness of feedback on the motivational variables were moderated by motivational characteristics of the subjects, the like task specific self efficacy. Hence, the way in which the informative component of feedback affects motivation has to be examined in more detail. Future research on this topic is particularly important with regard to the question on how to promote self-regulated learning with modern information technologies.

Contact:

Dr. Susanne Narciss
Institut fuer Psychologie IV
Technische Universitaet Dresden
01062 Dresden
Germany

Phone: +49 351 463 6059
FAX: +49 351 463 7294
Email: narciss@rcs.urz.tu-dresden.de

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